Claims

1   1. A lithography system comprising:

2   a plurality of lens elements;

3   a lens enclosure establishing a controlled environment between the lens elements

4   in the plurality of lens elements, the plurality of lens elements having a first lens element

5   adapted to face a source of radiation, and having a final lens element comprising a

6   material with an index of refraction greater than 1, and having a surface adapted placed in

7   contact or in close proximity with the sample; and

8   a stage to support said sample in contact or in close proximity with the surface of

9   the final lens element.

1   2. The lithography system of claim 1, wherein the material of said final lens element

2   comprises one of silicon dioxide, calcium fluoride, aluminum oxide, yttrium fluoride,

3   lanthanum fluoride, strontium fluoride.

1   3. The lithography system of claim 1, wherein said plurality of lens elements projects

2   radiation having a wavelength of about 193nm to the sample.

1   4. The lithography system of claim 1, wherein said plurality of lens elements projects

2   radiation having a wavelength of about 157nm to the sample.

1   5. The lithography system of claim 1, including a mask between the source of radiation

2   and said plurality of lens elements, and said plurality of lens elements demagnifies an

3   object on the mask by a factor greater than 4 at an image plane on or near said sample.

1   6. The lithography system of claim 1, including a mask between the source of radiation

2   and said plurality of lens elements, and said plurality of lens elements projects an image

3   of an object on the mask at an image plane on or near the surface of the final lens adapted

4   placed in contact or in close proximity with the sample.

1 7. The lithography system of claim 1, wherein said sample has a layer adapted to be
2 developed in response to radiation projected by the plurality of lens elements, said layer
3 having an index of refraction, and wherein said final lens element comprises a material
4 having an index of refraction matching the index of refraction of said layer.

1 8. The lithography system of claim 1, wherein the final lens element comprises a
2 removable slab of said material.

1 9. A lithography system comprising:
2   a projection lens for imaging an object on a mask onto a sample, one side of the
3 projection lens adapted to be placed in contact or in close proximity with the sample and
4 an other side of the projection lens adapted to be placed in contact or in close proximity
5 with the mask; and
6   a stage to support said sample in contact or in close proximity with the projection
7 lens.

1 10. The lithography system of claim 9, wherein a material of a lens element of said
2 projection lens adapted to be placed in contact or in close proximity with the mask,
3 comprises a material including one of silicon dioxide, calcium fluoride, aluminum oxide,
4 yttrium fluoride, lanthanum fluoride, strontium fluoride.

1 11. The lithography system of claim 9, wherein said projection lens projects radiation
2 having a wavelength of about 193nm from the mask to the sample.

1 12. The lithography system of claim 9, wherein said projection lens projects radiation
2 having a wavelength of about 157nm from the mask to the sample.

1 13. The lithography system of claim 9, wherein said projection lens demagnifies an
2 image on the mask by a factor greater than 4 at an image plane on or near said sample.

1 14. The lithography system of claim 9, wherein said projection lens, includes a lens

2 having a surface adapted to be placed in contact or in close proximity with the sample,

3 and projects an image of a mask at an image plane on or near said surface of said lens.

1 15. The lithography system of claim 9, wherein the lens having a surface adapted to be

2 placed in contact or in close proximity with the sample comprises a removable slab of

3 said material.

1 16. A method for manufacturing integrated circuits, comprising:

2   providing a sample having a layer adapted to be developed in response to

3 radiation;

4   providing a layout object to be projected on said layer;

5   placing said layer on said sample in contact or close proximity with a lens element

6 of a projection lens, wherein said lens element comprises a material having an index of

7 refraction for said radiation greater than 1; and

8   imaging the object on said layer through said projection lens.

1 17. The method of claim 16, including imaging the object at an image plane so that

2 evanescent waves emanating from the lens element transfer the image to said layer.

1 18. The method of claim 16, including imaging the object at an image plane near a top

2 surface of said layer.

1 19. The method of claim 16, including preventing adhesion of said lens element to said

2 layer.

1 20. The method of claim 16, including placing a mask including said layout object in

2 contact or close proximity with another lens element of a projection lens, wherein said

3 other lens element comprises a material having an index of refraction for said radiation

4 greater than 1.

1 21. The method of claim 16, including laying out a layout pattern on a mask including

2 the layout object to be imaged on said layer, said laying out including applying proximity

3 correction using a lithography model comprising, for an incident material different than

4 air characterized by its refractive index and absorption coefficient, calculating fields in

5 said layer, accounting for the incident material refractive index and absorption

6 coefficient, performed using thin film optics or by solving Maxwell equations.

1 22. The method of claim 16, including laying out a layout pattern on a mask including

2 the layout object to be imaged on said layer, said laying out including applying proximity

3 correction using a lithography model comprising, for an incident material different than

4 air characterized by its refractive index and absorption coefficient, calculating fields in

5 said layer, accounting for the incident material refractive index and absorption

6 coefficient, performed using thin film optics or by solving Maxwell equations, and

7 accounting for a gap between the incident material and the resist using thin film modeling

8 or by solving Maxwell equations.

1 23. The method of claim 16, including laying out a layout pattern on a mask including

2 the layout object to be imaged on said layer, the layout pattern comprising an alternating

3 aperture phase-shifting mask layout, said laying out including applying proximity

4 correction using a lithography model comprising, for an incident material different than

5 air characterized by its refractive index and absorption coefficient, calculating fields in

6 said layer, accounting for the incident material refractive index and absorption

7 coefficient, performed using thin film optics or by solving Maxwell equations.

1 24. The method of claim 16, including laying out a layout pattern on a mask including

2 the layout object to be imaged on said layer, wherein said imaging the object on said

3 layer through said projection lens, includes applying an off-axis setting for the projection

4 lens, the off-axis setting obtained using a lithography model comprising, for an incident

5 material different than air characterized by its refractive index and absorption coefficient,

6 calculating fields in the resist, accounting for the incident material refractive index and

7 absorption coefficient, performed using thin film optics or by solving Maxwell equations.

1   25. The method of claim 16, including laying out a layout pattern on a mask including

2   the layout object to be imaged on said layer, the layout pattern comprising an assist

3   feature having a size and a distance from a corresponding main feature, said laying out

4   including determining said size and distance using a lithography model comprising, for

5   an incident material different than air characterized by its refractive index and absorption

6   coefficient, calculating fields in said layer, accounting for the incident material refractive

7   index and absorption coefficient, performed using thin film optics or by solving Maxwell

8   equations.

1   26. The method of claim 16, including laying out a layout pattern on a mask including

2   the layout object to be imaged on said layer, the layout pattern comprising an attenuated

3   phase-shifting mask having sizing parameters, said laying out including determining said

4   sizing parameters using a lithography model comprising, for an incident material

5   different than air characterized by its refractive index and absorption coefficient,

6   calculating fields in said layer, accounting for the incident material refractive index and

7   absorption coefficient, performed using thin film optics or by solving Maxwell equations.

1   27. The method of claim 16, wherein the sample comprises a wafer including a plurality

2   of materials forming a wafer stack, and including laying out a layout pattern on a mask

3   including the layout object to be imaged on said layer, said laying out including applying

4   proximity correction using a lithography model comprising, for an incident material

5   different than air characterized by its refractive index and absorption coefficient, dividing

6   the refractive indices and absorption coefficients of all the materials in the wafer stack by

7   the refractive index of the incident material.